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Forest Insect and Disease Conditions in the Southwest - 1981

COVER PHOTO: An Air Tractor, model 302, applying acephate at 3/4-pound active ingredient per acre on ponderosa pine for pandora moth control in a pilot project near Jacob Lake, North Kaibab Ranger District, Kaibab National Forest, Arizona.

Forest Insect and Disease Conditions in the Southwest --- 1981

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Foreword

This report on the forest insect and disease conditions in the Southwest in 1981 was compiled from information provided by the Forest Pest Management staff, Regional Office; Robert Celaya, Arizona Forestry Division; and Tony Smith, New Mexico Department of Agriculture.

Because forest pest damages can significantly affect resource and environmental values, pest management must be considered an integral part of forest management. The major role of pest management specialists is to provide the technical information and assistance necessary to enable land managers to protect forest resources in the Southwestern Region. The Forest Pest Management program consists of the following activities: prevention, detection, evaluation, and suppression. In dealing with forest pests, entomologists and pathologists have used and continue to emphasize the use of integrated pest management (IPM). IPM involves the use of a variety of control methods--cultural, biological, and chemical--either singly, or in combination, to manage forest pests. Because many of the effects of forest pests can be prevented, efforts are being made to incorporate IPM strategies into all stages of the resource management planning and budgeting processes.

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Insect and Disease Conditions

Conditions in Brief

Tree mortality from bark beetles increased in 1981. Ponderosa pine mortality due to mountain pine beetle increased on the Kaibab Plateau, Ariz., and on the Navajo Indian Reservation, Ariz. and N. Mex. Ips bark beetles caused considerable ponderosa pine mortality on the San Carlos Indian Reservation, Ariz., and minor tree mortality in the rest of the Region. The spruce beetle caused significant tree mortality on the Fort Apache Indian Reservation, Ariz., and scattered pockets of mortality in the rest of the Region.

As in the past several years, defoliators were the most damaging forest insect pests in 1981. Western spruce budworm defoliation was heavy on the Kaibab National Forest and Grand Canyon National Park, Ariz., and the Carson, Cibola, and Santa Fe National Forests, N. Mex. Acres defoliated increased from 299,000 in 1980 to 477,960 in 1981. A small pine budworm infestation on the Los Alamos National Laboratory and Santa Fe National Forest, N. Mex., continued to cause light to moderate defoliation of ponderosa pine. The pandora moth defoliated 18,700 acres of ponderosa pine on the Kaibab National Forest, Ariz. Western tent caterpillar defoliation of aspen on the Santa Fe National Forest, N. Mex., decreased in acreage, but not intensity, and new areas of defoliation were observed in the San Pedro Parks Wilderness.

Southwestern dwarf mistletoe-caused ponderosa pine growth loss and mortality continued to be the most important effects of forest diseases in the Southwest. Thirty-seven thousand two hundred (37,200) acres of dwarf mistletoe-infected ponderosa pine stands were surveyed. Mistletoe control was performed on 1,291 acres.

Armillaria root rot caused heavy mortality of ponderosa pine sawtimber, poletimber, saplings, and seedlings on a 495-acre survey on the Santa Fe National Forest. Significant mortality in planted seedlings was caused by Armillaria root rot on the Apache-Sitgreaves National Forests.

Pinewood nematode was discovered in Pima County, Arizona.

Status of Insects

Mountain pine beetle, Dendroctonus ponderosae Hopk. The mountain pine beetle (MPB) caused small increases in ponderosa pine mortality in the northern portions of the Region. In Arizona, activity increased on the North Kaibab Ranger District, Kaibab National Forest and adjoining Grand Canyon National Park (figure 1). Widely scattered, small MPB "spots" occurred on the Chuska Mountains, which are primarily in New Mexico (figure 1), Navajo Indian Reservation. In New Mexico, the number of MPB-killed trees increased on the El Rito and Tres Piedras Ranger Districts, Carson National Forest, and on the Jemez and Espanola Ranger Districts, Santa Fe National Forest. Some of these infestation centers are now concentrated enough to possibly justify salvage programs in accessible areas. The MPB infestation on Archuleta Mesa, Jicarilla Indian Reservation, remained at about the same level as in 1980.

The MPB caused losses on State and private land in New Mexico in 1981. An infestation killed several hundred ponderosa pines on the Raton, N. Mex., watershed. Suppression efforts by salvage logging for firewood was conducted on eight private ownerships in the Idlewild recreational area.

Western pine beetle, Dendroctonus brevicomis LeC. This bark beetle caused considerable ponderosa pine mortality on the Blue Ridge, Long Valley, Flagstaff, and Mormon Lake Ranger Districts of the Coconino National Forest, Ariz. Salvage logging of accessible areas of concentrated mortality was recommended. Western pine beetle-caused mortality also increased on the Chalender and Williams Ranger Districts, Kaibab National Forest, Ariz. Elsewhere in the Region, the beetle caused widely scattered, single tree and small group mortality throughout much of the ponderosa pine type. Primarily, weakened mature or overmature trees were attacked. The Coronado and Apache-Sitgreaves National Forests, and the San Carlos and Fort Apache Indian Reservations in Arizona, and the Gila and Lincoln National Forests and Mescalero Apache Indian Reservation in New Mexico, all had scattered beetle-caused mortality (figure 1).

Pine engraver beetles, Ips spp. Isolated, small Ips infestations occurred in the ponderosa pine type throughout the Region. The only infestations of consequence were: (1) heavy mortality associated with management activities on the El Rito and Tres Piedras Ranger Districts, Carson National Forest; (2) concentrated mortality associated with fires, Chino Valley and Bradshaw Ranger Districts, Prescott National Forest; (3) concentrated mortality associated with fires, Alpine Ranger District, Apache-Sitgreaves National Forests; (4) heavy mortality associated with management activities on the San Carlos Indian Reservation; (5) ponderosa pine on private land in Prescott, Ariz.; (6) concentrated mortality on Kaiser Steel property and private land in Moreno Valley and Mora, N. Mex.; and (7) pinyon pine on private land in Flagstaff, Ariz.

Green slash was created in ponderosa pine stands on the San Carlos Indian Reservation for several continuous years. This resulted in an Ips lecontei Swaine outbreak in 1981. In these lower elevation areas, Ips lecontei is historically an aggressive attacker of pole-sized trees when sufficient host material to create large populations is provided.

Pine engraver beetle attacks on pinyon pine on private property in the Flagstaff, Ariz., area were less noticeable than in 1980. The Arizona Forestry Division has been providing landowners with information on this pest.

Spruce beetle, Dendroctonus rufipennis (Kirby). Spruce beetle-caused mortality remained at about the same levels in the Region, except on the Fort Apache Indian Reservation where a large, severe infestation in the White Mountains was detected (figure 1). This infestation is approximately 7,000 acres in size. Three million board feet of timber have been logged since September 1981, and additional salvage logging is planned for 1982.

On private land in New Mexico, the Baca Location No. 1, the spruce beetle killed large diameter Engelmann spruce on 180 acres. This population is declining and no salvage logging was performed in 1981.

Western spruce budworm, Choristoneura occidentalis Free. The western spruce budworm continued to cause extensive defoliation in mixed conifer stands in the Southwest (figure 1). Acres of visible defoliation observed by aerial detection surveys increased from 299,000 in 1980 to 477,960 in 1981. Areas with extensive defoliation 1/ included the Kaibab National Forest (95,250 acres) and adjoining Grand Canyon National Park (19,625 acres) in Arizona, and the Carson (97,250 acres), Cibola (13,750 acres), and Santa Fe (114,525 acres) National Forests in New Mexico. In addition, 80,000 acres of defoliation occurred on State and private lands in New Mexico. Heaviest defoliation on private land in New Mexico occurred in Moreno Valley. Acres and intensity of defoliation are summarized in table 1.

Egg mass densities per square meter of foliage dropped or remained at the same levels as in 1980 in most areas; however, the 1981 egg mass densities are still at epidemic population levels Region-wide.

The Western Spruce Budworm Suppression and Evaluation Project in the Jemez Mountains, Santa Fe National Forest, was sampled for the fifth consecutive year. Budworm populations and acreages defoliated increased in both treated and untreated areas, but the treated area still has considerably lower population levels and less defoliation than the untreated area.

1/ Figures for the National Forests include private lands adjoining or within National Forest boundaries.

Table 1: Status of western spruce budworm infestations, Southwestern Region, 1981.

Class	Outbreak area (Acres) L	M	H	TOTAL
National Forest	90,025	180,625	326,525	326,525
Other Federal 1/	5,300	15,539	200	21,039
Indian Reservations	2,975	32,226	4,950	40,261
State, county, or municipal	52,590	18,340	9,070	80,000
Nonindustrial, private	2,060	6,100	1,975	10,135

L = light; M = medium; H = heavy

1/ Includes lands administered by the National Park Service, Bureau of Land Management, and Department of Defense.

Pine budworm, Choristoneura lambertiana var. ponderosana Obraztsov. The pine budworm has caused light to moderate defoliation of ponderosa pine on the western one-third of the Los Alamos National Laboratory and adjoining Santa Fe National Forest lands since 1978. Some suppressed understory saplings were severely defoliated.

Pandora moth, Coloradia pandora Blake. The pandora moth infestation on the North Kaibab Ranger District, Kaibab National Forest, increased in 1981. No defoliation was observed in 1980, due to the insect's 2-year life cycle. Based on 1980 egg mass data, heavy defoliation was predicted for 1981 in the Jacob Lake area. Approximately 18,700 acres of ponderosa pine were defoliated in 1981 (figure 1).

A pilot spray project was conducted in May 1981 to evaluate the operational effectiveness of an aerial application of acephate against the pandora moth. Of eight blocks of 500 to 700 acres, five were sprayed and three were check blocks. Significant amounts of rain and/or snow fell after treatment on two of the blocks and reduced the effectiveness of the acephate spray. An average of a 58-percent population reduction occurred on the remaining spray blocks, and combined average defoliation in these blocks was 25 percent or less. The combined average defoliation on the check blocks was about 75 percent. Although population reduction was only 58 percent, the objectives associated with defoliation reduction to maintain esthetic quality were achieved.

A final report will be issued in early 1982, after complete analysis of data.

The pandora moth was identified in the Prescott, Ariz., area for the second consecutive year by the Arizona Forestry Division (figure 1). Defoliation was undetectable in 1981.

Western tent caterpillar, Malacosoma californicum (Pack.). The western tent caterpillar continued to defoliate aspen stands on the Santa Fe National Forest and adjacent private lands for the sixth consecutive year. Defoliation decreased markedly in area, but not in intensity. Also, there were several new areas of defoliation on the Forest. The caterpillar also defoliated nearly 14,000 acres of aspen on the Baca Location No. 1, N. Mex. This is 15,000 acres less than 1980. Egg mass surveys conducted on the National Forest in the fall indicate a decreasing trend where infestations have been present for a number of years, and an increasing trend in newly infested areas.

Western tent caterpillar also caused scattered areas of light to heavy defoliation on the Cibola, Carson, Kaibab, and Coconino National Forests, and the Fort Apache, Santa Clara, and Taos Pueblo Indian Reservations. The infestation on the North Kaibab Ranger District, Kaibab National Forest, increased greatly in size and intensity in 1981.

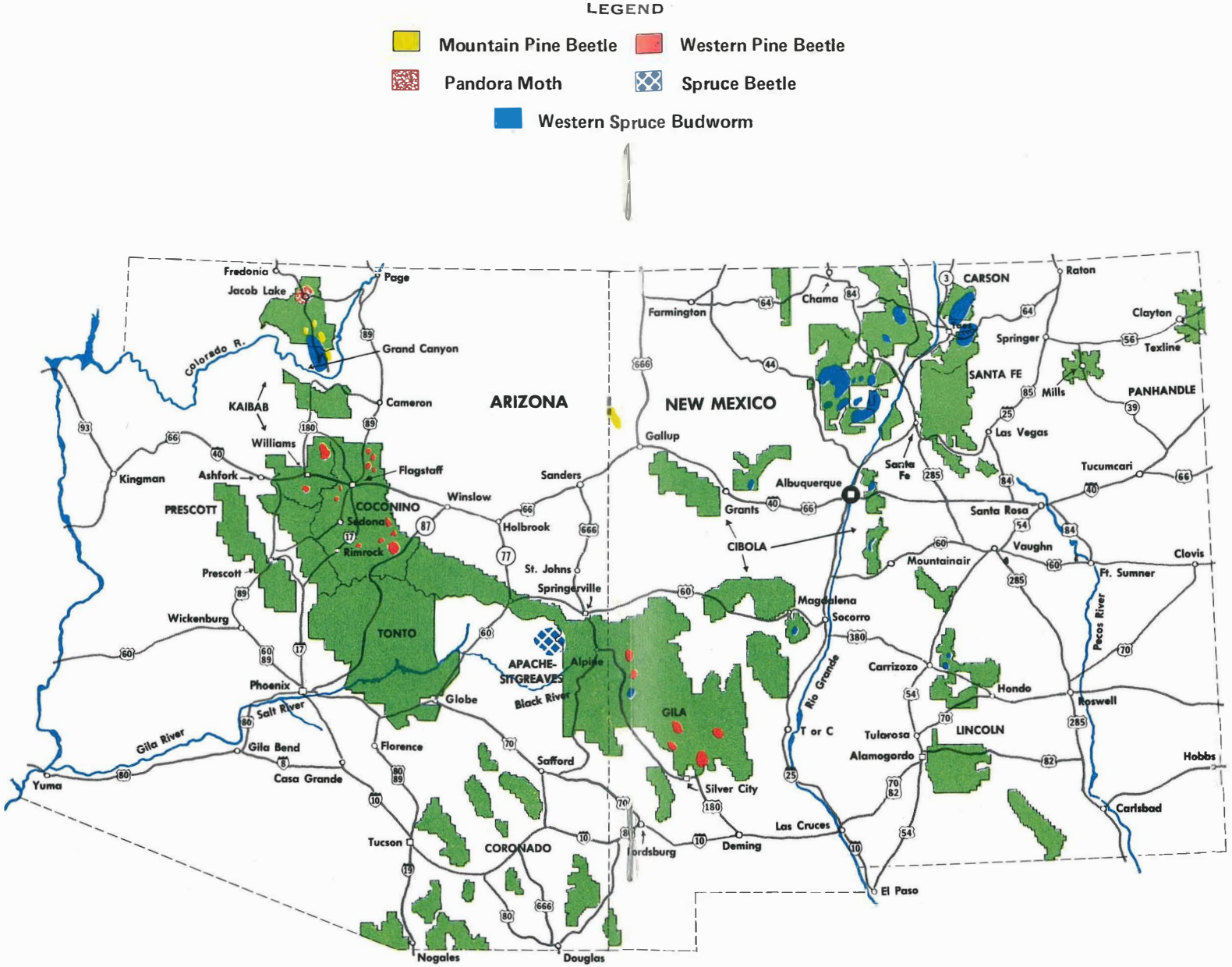

Figure 1. Locations of major insect infestations occurring in 1981, Southwestern Region.

Other Insects:

Name		Host	Locality	Remarks
Common	Scientific			
Cedar bark beetle	Phloeosinus spp.	Arizona cypress	Verde RD, Prescott NF	Attacking Arizona cypress in a plantation.
Cooley spruce gall aphid	Adelges cooleyi (Gillette)	Engelmann spruce	Smokey Bear RD, Lincoln NF, Lakeside-Pinetop, AZ.	Reported from the Smokey Bear RD and in the Lakeside to Pinetop area, and occurs throughout the Region.
Douglas-fir beetle	Dendroctonus pseudotsugae Hopk.	Douglas-fir	Carson, Lincoln, Kaibab & Santa Fe NF's; Taos Pueblo, Ft. Apache, & Navajo IR's; Vermejo Ranch, Kaiser Steel, Philmont Ranch, NM.	Scattered singles and small groups. Widely scattered groups of 5 to 30 trees were killed on private land in NM. Heaviest losses were detected on the Vermejo Ranch in mature and over-mature stands. Moisture stress contributed to the current situation.
Douglas-fir tussock moth	Orgyia pseudotsugata (McD.)	Douglas-fir, true firs, and spruce	Santa Fe, Ruidoso, Raton, N. Mex.	Infestations continued in Santa Fe and Ruidoso. A new infestation was detected in Raton.
Fir engraver beetles	Scolytus spp.	Douglas-fir & true firs	Kaibab, Lincoln, Apache-Sitgreaves, Coconino, Carson, Cibola, & Coronado NF's & Taos Pueblo, Ft. Apache, Navajo, & Mescalero IR's	Scattered spots of 1-10 trees, except on San Francisco Peaks, where it is killing hundreds of old decadent true firs on steep slopes, and on the Ft. Apache IR, where it is killing old decadent true firs in several drainages.
Gall midge	Cecidomyiidae	Ponderosa pine	Long Valley RD, Coconino NF.	Samples submitted had midge larvae and needle symptoms similar to the pinyon spindle gall midge.
Hardwood scale	Diaspididae	Aspen	Flagstaff, AZ	Possible oystershell scales on ornamental aspen in and around town.
Hylastes root bark beetles	Hylastes spp.	Douglas-fir	Bradshaw RD, Prescott NF	Caused scattered Douglas-fir mortality in conjunction with Scolytus spp. beetle.
Leafhoppers	Cicadellidae	White fir	Long Valley RD, Coconino NF; Alpine RD, Apache-Sitgreaves NF's	Observed on trees in logging areas and on new foliage.

Name		Host	Locality	Remarks
Common	Scientific			
Mealy bugs	Pseudococcidae	Ponderosa pine	Chevelon RD, Apache-Sitgreaves NF's	Found feeding on recently planted seedlings' roots.
Oak leaf skeletonizer-tier	Unidentified	Gambel oak	Chama, NM	About 100 acres were completely defoliated.
Pine butterfly	Neophasia menapia (Felder and Felder)	Ponderosa pine	Show Low to Pinetop, AZ.	No noticeable defoliation.
Pine needle sheathminer	Zelleria haimbachi Busck.	Ponderosa pine	Flagstaff, AZ.	Tentatively identified, will be confirmed in 1982. Damage was widespread.
Pinyon needleminer	Coleotechnites edulicola (Hodges & Stephens)	Pinyon pine	Navajo IR, AZ.	Scattered pockets.
Pinyon needle scale	Matsucoccus acalyptus Herbert	Pinyon pine	Prescott, AZ.	Early female emergence in March has been observed for 5 years. However, egg hatch is in May, which is normal.
Pinyon spindle gall midge	Pinyonia edulicola Gagne	Pinyon pine	Chevelon RD, Apache-Sitgreaves NF's	
Ponderosa pine needleminer	Coleotechnites spp.	Ponderosa pine	Navajo IR; Cuba RD, Santa Fe NF. Also observed on Cibola, Gila, and Apache-Sitgreaves NF's and Ft. Apache and San Carlos IR's.	There was a dramatic increase of these insects observed this year. Damage could be observed in nearly any ponderosa pine stand in the Region. Although defoliation was noticeable, damage was minor.
Red turpentine beetle	Dendroctonus valens LeC.	Ponderosa pine	San Carlos IR, Lakeside-Pinetop, AZ.	Attacking stressed trees, often with Ips beetles, particularly in prescribed burns on private land in the Pinetop area. Widely scattered activity Region-wide.
Sawflies	Neodiprion spp.	Pinyon pine, ponderosa pine, Douglas-fir	El Morro National Monument; Guadalupe National Park; Chalender RD, Kaibab NF, Springerville, AZ.	Pinyon in El Morro; Douglas-fir in Guadalupe. Localized or single trees were defoliated. Pole-sized ponderosa pines in Springerville on open areas have been defoliated for several years.
	Zadiprion townsendi (Cockerell)	Ponderosa pine	Manzano Mountains, NM	Several acres of pole-sized trees were heavily defoliated for the third consecutive year.

Common Name	Scientific Name	Host	Locality	Remarks
Scarab beetles	Phyllophaga sp.	Cottonwoods	San Simon Res. Area, BLM, Safford, AZ.	Approximately 50 cottonwoods were defoliated.
Tiger moths	Halisidota ingens Hy. Edwards	Ponderosa pine, pinyon pine	Williams RD, Kaibab NF; Quemado RD, Gila NF	
Twig weevil	Cylindrocopturus obscorellos (Casey)	Ponderosa pine	Prescott, AZ	Flagging has been observed for 4-5 years, with damage most apparent this year. Adults were identified in September 1981.
Whitemarked tussock moth	Orgyia leucostigma (J. E. Smith)	Gambel oak	Raton, NM	Light to moderate defoliation on more than 1,000 acres, north of Raton.

Status of Diseases

Dwarf mistletoe. Arceuthobium spp. Southwestern dwarf mistletoe, A. vaginatum subsp. cryptopodum (Engelm.) Hawks. & Wiens, continued to have a major impact on growth and yield of ponderosa pine in Region 3. Thirty-four thousand two hundred and fifty-one (34,251) acres of infected ponderosa pine on seven Ranger Districts were surveyed. The data collected were used to run the RMYLD simulated yield program to assist in planning management alternatives for the infected stands.

Root diseases. Armillaria and annosus root rots were found to have caused the loss of 10 percent of the sawtimber volume and 12 percent of the pole-sized trees since the stand was last logged in 1973-74. Approximately 500 acres were surveyed for root diseases on the Jemez Ranger District, Santa Fe National Forest. Armillaria root rot also killed ponderosa pine saplings and Douglas-fir poles in the Chiricahua Mountains, Coronado National Forest.

Six National Forests in northern New Mexico and northern Arizona were surveyed for root diseases and associated pests using the Pest Damage Inventory (PDI) System developed by Region 5. Photography was flown by Region 5 personnel and interpreted by Region 3 and Region 5 personnel and by a contractor. Field data were collected by a crew from Region 3 with assistance from Region 2 and Region 4. Data are now being analyzed.

Nursery diseases. Pre- and post-fumigation surveys of population levels of soil-borne pathogens at the Albuquerque Tree Nursery were conducted in the spring of 1981. Prefumigation populations of Fusarium spp. and Pythium spp. were as high as 1,543 and 6 propagules per gram (ppg), respectively. Spring fumigation was effective in reducing levels of Fusarium and Pythium to 53 ppg and 1.1 ppg, respectively.

Other Diseases:

Name		Host	Locality	Remarks
Common	Scientific			
Abiotic disease Winter damage		Ponderosa pine, white fir	Sierra Vista RD, Coronado NF, AZ; Elden RD, Coconino NF, AZ; Reserve RD, Gila NF, NM; and Cuba RD, Santa Fe NF, NM	
Cankers	*Cryptosphaeria populina* (Pers.) Sacc	Aspen	Douglas RD, Coronado NF	
Needle casts	*Elytroderma deformans* (Weir) Darker	Mexican pinyon pine	Big Bend National Park, TX	First record of *E. deformans* on *P. cembroides* and on *P. discolor*.
		Border pinyon	Douglas RD, Coronado NF	
Vascular Wilts Pinewood nematode	*Bursaphelenchus xylophilus* (Steiner & Buhrer) Nickle.	Aleppo pine	AZ	The nematode was discovered in Pima County in southern AZ.

Forest Pest Management Activities in 1981

The Forest Pest Management (FPM) staff of the USDA Forest Service in Region 3 is charged with responsibility for detection, evaluation, and suppression of forest pests, and for providing technical assistance to forest land managers on all Federal lands in Arizona and New Mexico. In addition, FPM personnel also cooperate with the States of Arizona and New Mexico in carrying out forest pest management activities on State and private lands through the Cooperative Forest Pest Action Program.

Detection Surveys

A major FPM responsibility is detection and monitoring of insect and disease infestations. This is accomplished by both low-level aerial and ground surveys.

Aerial surveys are used to detect new, and monitor ongoing, infestations by determining the location and extent of damage. A total of 10,820,000 acres were surveyed from July through September 1981. Table 2 lists acres surveyed by State and management class.

After the surveys are completed, maps showing location, extent, and kinds of outbreaks occurring are sent to the resource managers of the respective administrative units.

Table 2: Acres aerially surveyed in the Southwestern Region in 1981 by State and landownership.

STATE	MANAGEMENT CLASS	ACRES (millions)
Arizona	National Forest System	3.26
	National Park System	0.16
	Indian Reservations	1.65
	State and Private Lands	0.00
New Mexico	National Forest System	3.72
	National Park System	0.02
	Indian Reservations	0.69
	State and Private Lands	1.32
TOTAL		10.82

Ground surveys are used when accurate or detailed information cannot be obtained by aerial surveys. The State of Arizona performed ground surveys on 32,000 acres of private lands and 3,000 acres of State lands for a variety of insect pests.

Field Surveillance

Land managers and forest workers should be alert for any unusual insect or disease activity as they conduct their normal field activities. Aerial surveys can only detect damage that has occurred, while forest workers in the field can often discover the beginning of a potential problem. Prompt reporting of new or unusual insect or disease activity is necessary for early detection of potential pest problems. Detection forms and surveillance kits are provided to forest managers. Managers should report information on the Forest Insect and Disease Surveillance Work Sheet forms furnished by FPM. Check appropriate boxes and make sure all pertinent information is provided. Probably the most important section of the work sheet is the "Remarks" section, in which managers can further describe the nature of the problem. Often, it is the comments in the remarks section that are the most helpful to entomologists and pathologists in identifying the problem.

Evaluation

FPM specialists not only inform forest managers of existing and potential problems, but provide evaluations containing recommendations on how to manage pest problems utilizing a variety of approaches.

Entomology: The following new and continuing activities were performed: (1) western spruce budworm population monitoring, and completion of the silvicultural prescriptions on the western spruce budworm silvicultural demonstration area, Carson National Forest; (2) fifth year western spruce budworm population monitoring on a suppression and evaluation project designed to determine long-term effects of treatment with a carbaryl spray, Santa Fe National Forest; (3) fourth year loss assessment survey to determine tree damage and losses from western spruce budworm in relation to population dynamics of the insect; (4) cooperative project with the State of New Mexico on private land to pilot test B.t. applied aerially on large areas with low-level western spruce budworm populations; (5) cooperative pilot project with Forest Service Research to evaluate the operational effectiveness and impact of an aerial application of acephate against the pandora moth, Kaibab National Forest; and (6) a field evaluation to determine the extent and severity of a spruce bark beetle infestation in the White Mountains, Fort Apache Indian Reservation, Ariz.

Pathology: The following new and continuing activities were performed: (1) a mistletoe control project to poison infected overstory trees on 800 acres on the Tusayan Ranger District, Kaibab National Forest, was completed, and a postsuppression evaluation of this project is scheduled in 1982; (2) a biological evaluation of dwarf mistletoe in a summer home area in Horsethief Basin Recreation Area, Bradshaw Ranger District, Prescott National Forest, was completed, and a dwarf mistletoe control project resulting from this evaluation, consisting of thinning or pruning and removing infected trees, was also completed; (3) a dwarf mistletoe suppression project on the Blanco Sale, Espanola Ranger District, Santa Fe National Forest, consisting of removing infected trees, was initiated and the target for Phase I of the 3-year project was set for 400 acres; as of August 20, 1981, the District had completed 500 acres; (4) personnel from the University of Arizona, in cooperation with Rocky Mountain Forest and Range Experiment Station and Region 3, collected data on the last 120 plots for the Southwestern Mixed Conifer Yield Program, and the data collected over the last 3 years will be analyzed this winter and a program will be written in 1982; (5) evaluation of dwarf mistletoe on several areas of the Jemez Indian Reservation, N. Mex.; (6) evaluation of dwarf mistletoe on several ponderosa pine stands on the Santa Clara Indian Reservation, N. Mex.; (7) evaluation of dwarf mistletoe on several ponderosa pine stands on the Isleta Indian Reservation, N. Mex.; (8) evaluation of dwarf mistletoe on several ponderosa pine stands on the Picuris Pueblo Grant, N. Mex.; (9) evaluation of hazard trees and dwarf mistletoe in six summer home areas, Payson Ranger District, Tonto National Forest, Ariz.; (10) evaluation of potential hazard trees in campgrounds on the Penasco Ranger District, Carson National Forest, N. Mex.; and (11) evaluation of results of 1981 spring fumigation, Albuquerque Tree Nursery, Cibola National Forest, N. Mex.

Recent Publications

Beatty, Jerome S. 1981. Biological evaluation, dwarf mistletoe in Horsethief Basin summer home area, Bradshaw Ranger District, Prescott National Forest, Ariz. R-3 81-10.

Beatty, Jerome S. 1981. Biological evaluation, hazard trees and dwarf mistletoe in six summer home areas, Payson Ranger District, Tonto National Forest, Ariz. R-3 82-1.

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Massey, C. L., and Douglas L. Parker. 1981. Arizona five-spined ips. Forest Insect and Disease Leaflet 116. USDA Forest Serv. 6 pp.

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Rogers, T. J. 1982. Biological evaluation, western spruce budworm, Carson National Forest and Taos Indian Pueblo, N. Mex. R-3 82-3.

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Telfer, William G. 1982. Biological evaluation, western spruce budworm, Santa Fe National Forest and Jemez Indian Pueblo, N. Mex. R-3 82-2.

Wulf, N. William, and T. J. Rogers. 1981. Western spruce budworm silvicultural demonstration area establishment report. R-3 81-11.

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